Touch sensitive scan area selection apparatus and method

FIELD OF THE INVENTION

[001] The present invention relates generally to document and image scanners.

BACKGROUND OF THE INVENTION

[002] A typical desktop scanner is capable of scanning documents or photographs of a size typical of a printed page. A common scanner size allows a scanner user to scan original items up to about 8.5 by 11.7 inches, encompassing both the "letter" and A4 standard paper sizes. However, a scanner user often wishes to scan only a portion of a page, or wishes to scan a photograph or other item that is smaller than a standard paper size. Many modern scanning systems enable system users to specify what portion of the available scanning area is to be scanned. Often, the system performs a preview scan, displays a low-resolution image of the scanning area on a computer screen, and allows the user to designate an area to be captured in a "final" scan. A preview scan is often done at a relatively low resolution, and is often used for setting various scanning parameters such as exposure and color balance, and for scan area designation. The preview scan data is typically discarded once it has been analyzed and the scanning parameters have been determined. A final is a scan from which the data is to be used for printing, storage, incorporation into an electronic document, or for some other purpose, and is often performed using parameters determined from the preview scan data. While a final scan often follows a preview scan, a final scan may be performed without a preview scan.

[003] The area designation is often accomplished with a computer mouse or other pointing device by outlining the desired area in the computer display of the preview scan. The preview scan may be initiated by selecting a function in software operating on the computer, or may be initiated by pressing a button on the scanner itself. Some systems perform automated region classification and selection, based on analysis of the results of a preview scan, so that a user need only designate, often with a single mouse click, which of the suggested regions displayed on the computer screen represents the area to be captured in the final scan.

[004] While these methods represent significant improvements over earlier methods that preceded them, they still require the user to interact with both the computer and the scanner. Furthermore, if the original item moves during the interval between the preview scan and the final scan, the user may have no indication that the movement happened and the resulting final scan may not encompass the original item of interest.

[005] There is a need for improved scanning area designation.

SUMMARY OF THE INVENTION

[006] A "see-through" scanner comprises a touch-sensitive panel that enables a scanner user to designate an area to be scanned by touching the scanner.

BRIEF DESCRIPTION OF THE DRAWINGS

[007] Figure 1 schematically shows a perspective view of a "see-through" scanner.

[008] Figure 2 shows the see-through scanner of Figure 1 raised from its scanning position so that its front side is visible to the viewer

[009] Figure 3 shows a partially exploded perspective view of a see-through scanner in accordance with an example embodiment of the invention.

[0010] Figure 4 shows the scanner of Figure 3 in an example mode of use.

[0011] Figure 5A depicts one example arrangement and interconnection of the components of a scanning system in accordance with an example embodiment of the invention, in block diagram form.

[0012] Figure 5B depicts an alternate example arrangement and interconnection of the components of a scanning system in accordance with an example embodiment of the invention, in block diagram form.

[0013] Figure 6 shows a computer monitor with an example scanning software user interface displayed on it, and its relationship to the scanner of Figure 3 in an example mode of use.

[0014] Figure 7 shows a partially exploded view of a see-through scanner in accordance with another example embodiment of the invention.

[0015] Figure 8 shows the scanner of Figure 7 in an example mode of use.

[0016] Figure 9A shows an example arrangement of components of a scanning system comprising the scanner of Figure 7.

[0017] Figure 9B shows an alternate example arrangement of components of a scanning system comprising the scanner of Figure 7.

DETAILED DESCRIPTION

[0018] Figure 1 schematically shows a perspective view of a "see-through" scanner **100**. In Figure 1, see-through scanner **100** is shown in a "face down" configuration, so that that back side **101** of the scanner is toward the viewer, and the scanner is in position to scan items that are under it, on a support surface **102**. See-through scanner **100** has a substantially transparent window **103** on back side **101**.

[0019] Figure 2 shows see-through scanner **100** raised from its scanning position so that the front side **201** of the scanner is visible to the viewer. Front side **201** of see-through scanner **100** has a substantially transparent platen **202**, through which an imaging assembly **203** can capture a digital image of an original item **204** when the original item **204** and the platen **202** are in relatively close proximity. The designations "front" and "back" are chosen arbitrarily, and may be interchanged.

[0020] Imaging assembly **203** provides illumination of the original item **204**, and collects light reflected from original item **204**. The reflected light is projected onto a sensor that has elements arranged generally linearly. Each sensor element accumulates an electrical charge in proportion to the intensity of light falling on it. These charges are quantified and converted to a numerical representation. Imaging assembly **203** is swept across original item **204** by a scanning mechanism (not shown), and the sensor elements are read periodically so that the collection of sensor readings forms an array of numbers representing the reflectance of the original item **204** as measured at a grid of locations. The array of numbers may be called a digital image. When properly interpreted, the digital image is an essentially photographic representation of original item **204**. Often, scanner **100** transmits the digital image to a computer or other device for storage, display, modification, printing, or other uses. The transmission may be through an interface cable such as cable **205**, or may be accomplished wirelessly, such as by radio frequency signals, infrared signals, or by other means.

[0021] Figure 3 shows a partially exploded perspective view of a see-through scanner **300** in accordance with an example embodiment of the invention. See-through scanner **300** comprises a touchscreen **301** affixed proximate to substantially transparent window **302** on the back side of scanner **300**. Touchscreen **301** is shown displaced from window **302** in Figure 3 for ease of explanation. A touchscreen is generally a thin, substantially transparent device for communicating coordinate information to a computer or other device. Window **302** may preferably be made of polycarbonate, or another substantially rigid and transparent material.

[0022] Several technologies are available for making touchscreens. In the resistive type touchscreen, two thin, clear, electrically conductive layers are held a small distance apart by thin, clear spacers. A differential voltage is applied between the conductive layers through contacts at spaced-apart points on the layers, often the corners of a rectangular touchscreen. The assembly may be adhered to a substrate, often a glass or plastic substrate, and a relatively hard clear protective may be applied to the exposed surface. When a relatively concentrated force is applied to the assembly, such as by a finger, stylus, or other mechanism, the two conductive layers are forced into electrical contact, completing an electrical circuit between the differential voltage references. Electrical current can then flow from the spaced-apart voltage application points on one layer to the voltage application points on the other layer, through the point of contact between the layers formed when the force is applied. The total current flowing between the layers is made up of component currents flowing from each of the spaced-apart voltage application points, and the portion coming from each spaced-apart voltage application point is inversely related to the distance from that voltage application point to the contact point where the force was applied to the touchscreen. The location of the force application can therefore be calculated from measurements of the electrical currents flowing at each of the spaced-apart voltage application points.

[0023] In addition to the resistive type touchscreen, other types include the capacitive type and the surface acoustic wave type. A scanner in accordance with an embodiment of the invention may use any touchscreen technology. Touchscreen assemblies are available from commercial sources, such as Fujitsu Components

America, Inc. of Sunnyvale, California, USA, the 3M Company of St. Paul, Minnesota, USA, and Synaptics, Inc. of San Jose, California, USA.

[0024] In a first example embodiment, a see-through scanner **300** comprising a touchscreen **301** may operate as shown in Figure 4. In Figure 4, scanner **300** has been placed face down over original item **204**. A user of the scanner uses a pointing device such as stylus **401** or even a finger to trace perimeter **402** of an area to be captured in a scan. The multiple locations touched in the process of tracing perimeter **402** are sensed by touchscreen **301**. The user may simply trace around a projection of the perimeter of original item **204**, visible through the scanner, and the area to be scanned may be selected to include the area enclosed by perimeter **402**, as projected through scanner **300** to a platen on the front side of scanner **300**. The platen on the front side of scanner **300** is substantially transparent, and may preferably be made of glass, or another substantially rigid and transparent material.

[0025] For the purposes of this disclosure, a perimeter or other figure traced on the back side of a see-through scanner is taken to transfer by orthogonal projection to the front side of the scanner. In other words, tracing a perimeter on the back side of the scanner suffices to select, as an area to scan, the area of the platen enclosed by an orthogonal projection of the perimeter to the platen side of the scanner, even though the surface actually traced upon is displaced from the plane of the original item or the platen by approximately the thickness of the scanner.

[0026] Coordinate axes X and Y, shown in Figure 4, provide a reference frame for describing touch locations. For example, a particular point at which touchscreen **301** is touched may be described by a coordinate pair (x,y), giving the location of the touch point in the two coordinate directions.

[0027] Figure 5A depicts one example arrangement and interconnection of the components of a scanning system **500** in accordance with an example embodiment of the invention, in block diagram form. Touchscreen **301** sends signals to a decoder circuit **501**, which translates the analog current measurements from touchscreen **301** into digital values **506** representing X and Y coordinates of locations where touchscreen **301** is touched. In this way, touch location information is generated indicating locations where touchscreen **301** is touched. Decoder circuit **501** may be a separate circuit, possibly placed near one edge of touchscreen **301**, or may be comprised in scanner control logic **502**. Scanner control logic **502** may include a microprocessor system, dedicated hardware, or both, and controls the motion and operation of an imaging assembly **503**. Scanner control logic **502** may also communicate with a host computer **504**, and may accept inputs from the scanner user through user controls **505**. User controls **505**, for example, may comprise buttons or other controls for communicating to the scanner when to start a scan, the intended use for the digital image, or other information. Scanner control logic **502** may also comprise memory for storage of a portion or all of a digital image resulting from a scan, and may perform other functions.

[0028] In one example mode of use, a scanner user may place scanner **300** face down on original item **204**, trace perimeter **402** to indicate an area to be scanned, and press a user control button **505** to start the scan. Scanner control logic **502** may be enabled to interpret the signals from decoder circuit **501** and configure itself to scan only the desired area. Alternatively, scanner **300** may send the signals **506** from decoder circuit **501** to a host computer **504**, which is configured to interpret the signals and then send configuration information back to scanner **300** for selecting an area to be scanned. The configuration information is derived from the touch location information carried in signals **506**. This alternate example arrangement is shown in Figure 5B. Signals **506** may pass through an interface that also carries other signals **507**. The user may initiate the scan by pressing a user control **505**. In this alternate arrangement, more of the process of scanner configuration is performed in the host computer, which may provide for more flexibility and may enable a simpler scanner design.

[0029] In this example mode of use, the scanner user interacts with the scanner throughout the entire process of setting up and initiating a scan. The user need not shift his or her attention from one device to another. The complexity of the process is reduced and the reliability of the process is improved as compared with other methods.

[0030] In designating an area to scan, the user need not trace a perfectly rectangular perimeter, and the perimeter need not be fully closed. The logic interpreting the touch location signals **506**, be it scanner control logic **502** or host computer **504**, may "rectangularize" the touch location information. For example, the logic may select for scanning a rectangular area that encompasses all of the sensed touch locations. Such a rectangular area can be selected by specifying a rectangle whose X-direction extent extends from the smallest to the largest of the X coordinates of all the sensed touch locations, and whose Y-direction extent extends from the smallest to the largest of the Y coordinates of all the sensed touch locations. Using this selection technique, a perimeter or other figure drawn imperfectly will suffice to select a scan area that encompasses original item **204** so long as the drawn perimeter extends beyond the perimeter of original item **204** at one location or more on each perimeter side. Similarly, the user could select a scanning area that encompasses original item **204** by simply making a diagonal stroke across touchscreen **301**, from a point near one corner of original item **204** to the opposite corner. The user could similarly select an entire page for scanning by tracing a single stroke from one corner of window **302** to the opposite corner.

[0031] The logic interpreting the touch location signals **506** may attempt to reduce the probability of responding to extraneous touches of touchscreen **301**. For example, the logic may restrict its consideration to touches that occur in a fixed time interval. For example, the logic may, in selecting a scan area, consider only touches that occur in the 10 seconds immediately prior to the initiation of a scan. Alternatively, the user may perform a reset, or clearing operation by pressing a user control **505**, and the logic interpreting the touch location signals **506** may consider only touches that occur after the reset or clearing operation.

[0032] In another example mode of use, scanner **300** interacts with automated region detection software executing on host computer **504**. In this mode of use, a scanner user initiates a preview scan, either by actuating a scanner user control **505** or through a software user interface on computer **504**. A preview digital image is transmitted to computer **504** and displayed as shown in Figure 6. Figure 6 shows a computer monitor **600** with an example scanning software user interface displayed on it, and its relationship to scanner **300** in this example mode of use. In the example display of Figure 6, the original item that has been the subject of the preview scan may be a magazine or book page containing regions of text and photographs. The automated region detection software has analyzed the preview digital image and identified five regions that are likely to be the subject of desired scans, and has presented the user with a depiction of them. The user of the system may select one of the regions by simply touching scanner **300** over that region of the page, for example with an object such as stylus **401** or with a finger. For example, if the user is interested in a final scan of only the photograph in region 2, the user can simply touch scanner **300** on touchscreen **301** over that photograph, as is shown in Figure 6. The location of the touch is noted, and only that area is scanned for later use. For example, the location of the touch may be transmitted to computer **504**, and computer **504** may send configuration commands to scanner **300** to accomplish the scan area designation. The final scan may be started automatically upon receipt of the scan area designation. Alternatively, the scanner itself may, using internal logic, perform the automated region detection, and configure itself to perform a final scan encompassing only the region that encompasses the touch location. In this configuration, the scanner need not transmit the preview digital image to a computer for processing.

[0033] Automated region classification and selection software is known in the art. Several methods are described in Pavlidis, et al., "Page Segmentation and Classification," CVGIP: Graphical Models and Image Processing, vol. 54, No. 6, Nov. 1992, pp. 226-238.

[0034] In yet another example mode of use, the scanner user may start a scan by simply touching scanner **300** on touchscreen **301** over the portion of original item that the user desires to scan. Scanner **300** then initiates a preview scan, transmits the preview digital image and the touch location to host computer **504**, which performs automated region detection. Once computer **504** has identified the regions of the original item that are likely to be desired final scan areas, it determines which region encompasses the touch location, and sends configuration information to scanner **300** such that scanner **300** is configured to perform a final scan that encompasses only that region. The final scan may be initiated upon receipt of the configuration information. Alternatively, the scanner itself may, using internal logic, perform the automated region detection, and configure itself to perform a final scan encompassing only the region that encompasses the touch location. In this configuration, the scanner need not transmit the preview digital image to a computer for processing.

[0035] Figure 7 shows a partially exploded view of a see-through scanner **700** in accordance with another example embodiment of the invention. In this example embodiment, see-through scanner **700** comprises a touchscreen **701** and a liquid crystal panel **702** affixed proximate to a substantially transparent window **703** on the back side of see-through scanner **700**. Liquid crystal panels are known in the art, and typically comprise two light-polarizing sheets with an array of individually-addressable liquid crystal elements sandwiched between the light-polarizing sheets. The light-polarizing sheets are oriented so that their polarization directions are substantially perpendicular. The liquid crystal elements have the property that the polarization of light passing through each element is responsive to an electrical voltage across the element. When an element is supplied with a voltage such that the polarization of light passing through the element is rotated about 90 degrees, light entering one of the polarizing sheets at that element can pass through the second polarizing sheet as well because its polarization has been modified by the liquid crystal in between. When an element is supplied with a voltage that leaves the polarization of light passing through the element essentially unchanged, light entering one of the polarizing sheets at that element is blocked when it encounters the second polarizing sheet. The element voltages are typically applied through electrical conductors made of a transparent material, so that the panel is substantially transparent when the elements are in their light-transmitting state.

[0036] Each liquid crystal element thus forms a small light shutter. When an element is configured to block light passing through it, objects behind that element will not be visible through it. When an element is configured to pass light through it, objects behind the element will be visible. A liquid crystal panel is a component of the familiar and widely-available liquid crystal display (LCD) used, for example, in many portable computers.

[0037] Example scanner **700** uses the light shuttering function of liquid crystal panel **702** in conjunction with touchscreen **701** to provide an image area selection method with user feedback. One example mode of use is depicted in Figure 8. In this example mode of use, the user selects a scan area by tracing around the portion of an original item that the user desires to scan. The original item is visible through the scanner because both the top and bottom of the scanner are generally transparent. The tracing may be done with an object such as stylus **801**, or simply with the user's finger. Touchscreen **701** detects and reads the locations of the touches, and elements of liquid crystal panel **702** that are closest to the touch locations are switched to their light-blocking state, so the path traversed by the user's touch is marked by a darkened border **802** in liquid crystal panel **702**. Darkened border **802** gives the user convenient feedback about the scan area that has been selected.

[0038] Other methods of providing user feedback are possible. For example, if the touch location information obtained using touchscreen **701** has been rectangularized in order to select an area to scan, the rectangularized area may be outlined in liquid crystal panel **702** by switching the appropriate elements to their light-blocking state.

[0039] Figure 9A shows an example arrangement of components of a scanning system **900** comprising see-through scanner **700**. Touchscreen **701** detects touches of the top surface of scanner **700**. Decoder circuit 901 computes X and Y locations of the touches, and passes this information **906** to scanner control logic **902**. Scanner control logic **902** causes liquid crystal panel **702** to darken the liquid crystal elements in the same X and Y locations as the detected touches. Scanner control logic **902** also controls the operation of imaging assembly **903**, accepts input from user controls **905** and may communicate with a host computer **904**.

[0040] In an alternative arrangement, shown in Figure 9B, decoder circuit **901** supplies its touch location information **906** to host computer **904**, and host computer **904** also controls liquid crystal panel **702**. This arrangement may simplify the integration of the scan area selection system into the design of a scanner.

[0041] Once a scan area has been selected, a scan of that area may be initiated automatically upon closure of the area boundary drawn by the user on touchscreen **701**, may be initiated when the user actuates a user control **905** on scanner **700**, or may be initiated by indicating to scanning software running on host computer **904** that a scan is to be started. Darkened border **802** may be automatically cleared by returning all of the liquid crystal elements in liquid crystal panel **702** to their light-transmitting states at the end of a scan, or a user control on scanner **700** may enable clearing of the liquid crystal panel by the user.